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XV.—*Observations on the Affinities of the* Olacaceæ.

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The family of the *Olacaceæ*, first proposed by Mirbel, in 1813, under the name of *Olacineæ*, was placed by him near the *Aurantiaceæ*: Jussieu stationed it in proximity with the *Sapotaceæ*, while DeCandolle following the views of Mirbel arranged it close to *Aurantiaceæ*, a conclusion adopted by most succeeding botanists, and among these Endlicher and Meisner, who disposed it with *Aurantiaceæ*, *Meliaceæ*, *Humiriaceæ*, &c., in a class called *Hesperides*. Brongniart however followed the original views of Mr. Brown, in regard to the affinity of *Olax* with the *Santalaceæ*; but upon less satisfactory grounds, he associated with these the *Loranthaceæ*, excluding at the same time *Ximenia* from the family. Dr. Lindley in his 'Nixus Plantarum' and 'Natural System' offered a new view, by placing it, under the designation of the *Olacaceæ*, in the same alliance with the *Pittosporaceæ* and *Vitaceæ*, for which position few and not very satisfactory reasons could be offered. Mr. Bentham, in an excellent memoir on the *Olacineæ* (Linn. Trans. xviii. 676), proposed a new arrangement of the order into three distinct tribes, adding several new genera, together with his ingenious views in regard to its affinities, when he justly denied its relation with the *Aurantiaceæ*, although he admitted its approach to the *Humiriaceæ*, considering both these families to be approximate with the *Styraceæ*; and lastly he allowed, that through *Opilia* and *Cansjera*, the *Olacineæ* evidently osculate with the *Santalaceæ*. Finally, Dr. Lindley (Veg. Kingd. p. 43) repeated his former views, with some modifications, placing it in his alliance of the *Berberales*, together with *Droseraceæ*, *Berberidaceæ*, *Vitaceæ*, *Pittosporaceæ*, &c., an alliance which, as Dr. Asa Gray very justly remarks (Gen. Pl. Un. St. i. p. 78), "is there placed on peculiar grounds by no means compatible with ordinary views of botanical affinity." In

estimating the value of these conflicting opinions, I will endeavour to show, that notwithstanding their extreme divergence, they will allow of a considerable degree of approximation.

We have the strongest evidence of the approach of the *Olacaceæ* towards the *Santalaceæ*, in the singular and important consideration of the structure of the ovarium and the seed; and if we consider the biserial floral envelopes of many of the genera of the latter order to be calyx and corolla, both of which are often most distinctly developed, as in *Choretrum*, *Leptomeria*, *Leptonium* and *Mida*, as also in *Quinchamalium*, *Arjoona* and *Myoschilos*, it is clear that its relationship towards the *Olacaceæ* is infinitely stronger than with the *Thymeleaceæ*, *Proteaceæ* and *Lauraceæ*, to which, in fact, they claim but a most distant affinity. This consideration did not escape the penetration of Mr. Brown, who more than forty years ago, and some time before the establishment of the family of the *Olacaceæ*, suggested* that the floral envelope called perianthium in the *Santalaceæ* may be looked upon as analogous to the same organ called corolla in *Olax*, and the calycular appendages may be viewed as a distinct calyx, alike in both instances; and hence, with equal reason in one case as in the other, we may consider the floral envelopes to be dichlamydeous rather than monochlamydeous: or we may imagine, that at a very early period in the development of the bud, the calyx and corolla have become connate, and hence grown into one common envelope,—an hypothesis rendered very probable from the constant thickness of its substance, and its divisibility into two distinct laminæ. I was led to a similar conclusion many years since by the examination of the Chilean genera *Quinchamalium*, *Myoschilos* and *Arjoona*, which have all a very distinct calyx, while the more conspicuous envelope, hitherto called perigonium, is decidedly petaloid in texture. Under this point of view, a close relationship will be found to exist between the *Olacaceæ*, *Santalaceæ* and *Styraceæ*, to which perhaps may also be added the *Myrsinaceæ* (but not the *Primulaceæ*), and it would then remain to be decided, in what part of the system such an alliance ought to find its place. I will not at present stop to offer proof of the alliance of the *Santalaceæ* with the orders above-mentioned, as I shall shortly have to revert to that consideration, but assume the fact for the present as one that admits of little doubt, and proceed to speak of the affinities of the *Olacaceæ* in other quarters, taking this family within the limits it has hitherto embraced.

I have alluded to the relationship of the *Olacaceæ* with the *Styraceæ*, but in so doing it is requisite here to state, that I consider the *Symplocaceæ* as ordinally distinct from the *Styraceæ*,

* Prodr. 352.

as will be made apparent when I describe two new genera appertaining to the former family. Don first suggested this separation, but he does not appear to have been aware of all the facts that prove their want of identity. In the *Symplocaceæ* we find a calyx of five imbricate sepals, a corolla with very imbricated æstivation, numerous stamens, placed in many series upon the corolla, having ovate 2-lobed anthers, without intervening connective, an inferior ovarium, showing a strict union of its carpels into five complete cells, and seeds of very different structure. In the *Styraceæ*, on the contrary, we have a tubular calyx with an almost entire border, petals with a distinctly valvate æstivation, stamens in a single series, generally double the number of the petals, and therefore by turns, opposite and alternate with them; here the anthers are linear, dorsally affixed upon a very fleshy connective; the ovarium is superior, wholly free from the calyx, with a remarkable pulvinate depressed epigynous gland; it is 3-locular at base, the dissepiments separating from the axis about its middle, and gradually disappearing at the apex, where it is completely unilocular, the base of the style being hollow, and continuous with the cavity of the cell; the cionosperm rises in the axis above the point of the separation of the dissepiments, and to the axile column are attached three fleshy placentæ, each bearing several ovules (about nine) in three rows, the upper series being erect, the middle horizontal, the lowermost suspended, the summit of each ovule being borne upon a cupshaped strophiole, as in the *Celastraceæ*: of these only a single seed becomes matured, as in *Olacaceæ*; it differs however in being erect, and showing at its base the remains of the abortive ovules: the radicle of the embryo, enclosed in fleshy albumen, is directed to the point of attachment, as in *Olacaceæ*, but owing to the different position of the seed, it of course assumes a contrary direction, and points to the base of the fruit; the cotyledons are much larger and more foliaceous than in *Olacaceæ*. These points of structure are evidently quite opposite to what we find in the *Symplocaceæ*, and it is surprising they could ever have been associated together. The characters of the *Styraceæ* are however analogous to those of the *Olacaceæ*, and there exists a very close affinity between the two families. The corolla is in no degree more gamopetalous in *Styraceæ* than it is in *Olacaceæ*, for in both cases the petals are valvate in æstivation, at first cohere slightly by their margins, and finally separate nearly to the base, where a short portion always remains agglutinated, by the adhesion of a very thin annulus, from which the stamens originate; but upon removing this annulus the petals will be found to separate easily, and not to be really confluent into a gamopetalous tube. We also see in *Liriosma* the same tendency

to the adhesion of its parts, carried even to a greater extent than in any instance I have found in *Styraceæ*; and in *Schöpfia*, which is justly included by Mr. Bentham in the *Olacaceæ*, we see a still greater tendency to a confluence of its parts. If therefore the *Olacaceæ* have been placed by all botanists among the pleiopetalous orders, there can be no reason why the *Styraceæ* should be considered as a monopetalous family. The ovarium in *Styraceæ* is stated by most authors to be half inferior, but I have observed that at an early stage, and even after the fall of the flower, it is quite free, although partly surrounded by the tube of the calyx; and if it become subsequently agglutinated to the latter, it is probably only at a late period, as we find to occur in *Liriosma*.

The *Ebenaceæ*, by most botanists, have been held to be closely allied to the *Styraceæ*, but this does not appear to me quite evident. Though placed among *Corollifloræ*, it appears to me that they should rather be arranged among the polypetalous groups, for their petals are often quite distinct, or when united, cohere so slightly as to be separated by a little force. The stamens, although sometimes adnate to the corolla, are most generally free, or at least originate in a fleshy disk, which sometimes assumes the form of a very short hypogynous tube. In one Brazilian species of *Diospyros*, I have found the albumen in the seed to be distinctly ruminated, as in the *Anonaceæ*, the embryo having a terete radicle and broad foliaceous cotyledons, much resembling in structure that of *Monodora*. *Cargillia*, according to Mr. Brown, a genus of this family, so nearly approaches the *Anonaceæ*, that the typical species was described by Jacquin as the *Anona microcarpa* (Fragm. xl. tab. 44. fig. 7), and by Dunal as the *Monodora microcarpa*. In the Brazilian species of *Diospyros* above alluded to, the seeds are imbedded in pulp, and covered by a mucilaginous arillus: they are also compressed, with a linear, basal, and somewhat lateral umbilicus, forming a deep marginal furrow, into the bottom of which cavity the extremity of the radicle subtends, as in several genera of the *Anonaceæ**. *Monotheca* and *Reptonia*, placed in *Theophrasteæ*, appear, from the descriptions given of them, to have little in common with that family, and to belong rather to *Styraceæ*, if we consider the basal placentations, which I have shown to exist in this last-

* A precisely similar structure is found in *Diospyros Candolleana*, according to Wight's 'Icones,' plate 1222, fig. 8 to 11. In several other instances in this family, the albumen is depicted in the same work as being distinctly ruminated, so that this may probably be a general character of the order, although so remarkable a feature is not noticed in any botanical work. Gaërtner however hints at the fact, but only in one instance out of the many species of *Diospyros* he describes; *D. tetrasperma*, which has its "albumen radiato-striatum, quasi fibrosum."

mentioned order, as in the *Olacaceæ*; and the approximation of these genera to the *Anonaceæ* is again confirmed by the ruminated albumen of the seed of *Reptonia*. The relation of the *Ebenaceæ* with the *Olacaceæ* was, I believe, first pointed out by Jussieu, but few botanists have attended to the suggestion; from the indications just mentioned, it will probably be found, that a more fitting position for the *Ebenaceæ* in the system exists among the hypogynous Polypetaleæ, not far from the *Anonaceæ*, rather than in the monopetalous group, where it is placed in the 'Prodromus' of DeCandolle, and in the arrangements of other modern botanists.

Mr. Bentham in his memoir before quoted gives his opinion, that among dichlamydeous plants, the family of the *Humiriaceæ* approaches most to that of the *Olacaceæ*; but in this inference he had probably in view his tribe *Icacineæ*, which I propose to remove altogether from the order: I cannot indeed perceive any such approximation between the two families. In the *Humiriaceæ*, the æstivation of the corolla is imbricated or contorsive, the stamens are many-seried, and numerous in respect to the petals, generally united into a monadelphous tube, or combined in phalanges, and they have a singular expansion of their fleshy connective; the ovarium is surrounded at its base by a thin, and somewhat membranaceous dentate ring; it has four or five complete cells, which by the thickening of the axile placenta are often again divided by a transverse partition. The fruit is a berry, having a 5-celled osseous nut, the cells being often 2-locellate, and the seeds are provided with the usual integumental coverings. This is in no way analogous to what is seen in *Olacaceæ*; but the *Humiriaceæ* present a more manifest affinity with the *Symplocaceæ*.

A considerable degree of analogy between the *Myrsinaceæ* and *Olacaceæ* is shown in the position of its stamens opposite the petals, which present an æstivation so little imbricated as to be sometimes mistaken for being valvate; they agree also much in habit and inflorescence. In *Icacorea* the ovarium is unilocular, with four ovules attached to a central free placenta, of which sometimes only one becomes matured, as in *Olacaceæ*; but here the analogy ceases, as the æstivation of the corolla is contorsively imbricate and the seed presents all the characters of the *Myrsinaceæ*. This family has been arranged by most authors among the *Monopetaleæ*, but for the reasons before urged in regard to the *Ebenaceæ* and *Styraceæ*, it should be transferred to the *Pleiopetaleæ*. In *Mæsa*, *Samara* (*Choripetalum*, A. DC.), and *Embelia*, the corolla is decidedly pleiopetalous, and in the other genera of the order the petals are only slightly coherent at base, the ovarium being in all cases superior, except in *Mæsa*, where it is

said to be partly inferior, but probably not so at an early period. The disposition to produce red dots in all parts of the plant in *Liriosma*, as in the *Myrsinaceæ*, is common to several families of the *Thalamifloræ* of DeCandolle's arrangement. Some degree of analogy may also be perceived between the *Myrsinaceæ* and the *Anonaceæ*, *Lardizabalaceæ*, and *Menispermaceæ*, in the development of the ovule, in the arilliform growth of the placentary indusia, as constantly witnessed in the two former families, and frequently in the latter, and in the deeply concave hilum, formed by the increment of the seed around the placenta, which is drawn into its cavity, and the consequently somewhat arcuate direction of the embryo within the albumen, seen more especially in the tribe *Heteroclineæ* among the latter family. There are other considerations to be held in view, that the *Primulaceæ*, *Myrsinaceæ*, and *Theophrastaceæ*, offer a free central placenta within the ovarium, without any appearance of parietal septa, or any connexion of the placenta with the style: we see also in the *Illicibraceæ*, *Mesembryanthaceæ*, and *Portulacaceæ*, a somewhat analogous development; but in these cases we cannot imagine this to be the result of the rolling up of the placentary margins of one or more carpellary leaves, according to the hypothesis generally entertained; but we may rather conceive, that the margins of the carpellary leaves constituting the ovarium have not the power of developing ovuliferous placentæ, a power seemingly there confined to the rudimentary petiolar support or gynophorus, which throws out its placentary threads, that are free in *Portulacaceæ*, &c., but confluent in *Primulaceæ*, *Myrsinaceæ*, *Theophrastaceæ*, &c. This view is confirmed by the appearance of the lengthened thread that grows up from the torus with the elongation of its seed, and its placentary attachment, in the instance of *Ægiceras*. We may therefore look upon this mode of development as the opposite extreme of the case of the multilocular ovarium, where its intrafolded placentations unite in a central axis; and we may look upon the *Olacaceæ*, *Styraceæ*, &c., as forming an intermediate state of development. Under such an hypothesis, keeping in view the considerations before mentioned, it would tend to a more natural division of the system, to remove all the several orders, from the *Lentibulariæ* to the *Styraceæ*, from the position assigned to them in the arrangement of the 'Prodromus.' Yet because the development of the ovaria in these instances may be traced to somewhat similar causes, it does not necessarily follow that they must all be allied together, for other considerations of equal moment may tend to keep them far apart. Thus from circumstances before enumerated, the *Styraceæ* and *Myrsinaceæ* might be associated with the *Olacaceæ* and *Santalaceæ*, between *Berberidaceæ* and *Rhœades*, in a group that might be called *Cio-*

nospermæ, as I suggested on a former occasion (*huj. op.* vol. vii. p. 207), and in this group the anomalous genus *Aptandra* will naturally find its place. On the other hand, the *Sapotaceæ* with their truly axile placentation, the complete cells of their ovarium, and their corolla more pleiopetalous than monopetalous, appear more naturally allied to the *Aquifoliaceæ*, in which family the petals are also generally combined at the base into a tube. The *Ebenaceæ*, as before suggested, appear to belong to the neighbourhood of the *Anonaceæ* rather than of the *Aquifoliaceæ*, with which family they are strangely consociated by Dr. Lindley (Veg. Kingd. p. 594) in the same alliance with the *Gentianaceæ*, *Apocynaceæ*, &c. The affinity of the *Symplocaceæ* with the *Humiriaceæ* has been already indicated. The *Primulaceæ*, together with the *Lentibulariaceæ*, appear to have more relation with the *Plantaginaceæ* and *Hydrophyllaceæ*, an alliance that differs little from that shown by Dr. Lindley (Veg. Kingd. p. 637). The farther prosecution of these considerations would be foreign to the present purpose, and they are now only indicated with the view of assisting us in the determination of the true affinities of the *Olacaceæ*.

There is yet another family, to which the *Olacaceæ*, comprehending all the genera included in it by Mr. Bentham, will be found to offer many points of approximation,—I mean the *Aquifoliaceæ* of DeCandolle, the *Ilicineæ* of Brongniart, Endlicher and others; but I am not aware that this affinity has been before noticed. Many species of *Ilex* bear much the habit of the *Olacaceæ* and differ little in the structure of the flower from the tribe *Icacineæ*, except in the æstivation of the corolla and the unilocular apex of the ovarium. *Leretia*, indeed, bears a remarkable resemblance in its habit and inflorescence, and in the structure of its flowers, to a Brazilian species of *Villaresia*, differing principally in the æstivation of the corolla, and in the want of an inner carinated midrib in the petals; but in other points of arrangement there is very little variance, agreeing even in its unilocular ovarium, with two collateral ovules suspended almost parietally from near the apex of the cell. The structure of the fruit of *Villaresia* corresponds so far with that of the *Olacaceæ*, in having a single seed, with copious albumen, containing a small embryo near its summit, with a superior radicle, and small cotyledons. It may be well here to mention a fact, apparently yet unknown, which may serve to throw some better light upon the real affinities of the *Aquifoliaceæ*. I have found that the suspension of the ovules in the ovarium of *Villaresia* is not really parietal, as generally stated, for it is sometimes completely bilocular, with two ovules in each cell, collaterally suspended from each side of the dissepiment by a cupshaped

strophiole, like that seen in the ovules of the *Celastraceæ*; but in ordinary cases the ovarium is unilocular, only by the suppression of one of the cells, and the confluence of the dissepiment with the pericarpial covering, for it is then always somewhat gibbous, and its wall much thicker on the side of the abortive cell, towards which the style is then constantly somewhat lateral: this fact serves to bring the genus completely within the pale of the *Aquifoliaceæ*, as it is evident that its ovules are really suspended from the normal dissepiment, not parietally attached to the wall of an originally solitary carpel. It will also serve to guide us to the true position in the system of *Leretia*, *Pogopetalum*, and the rest of the somewhat extensive group of the *Icacineæ*, which I shall be able to prove to be quite distinct, in many leading and essential characters, from the *Olacaceæ*. *Rhaptostylum*, an anomalous genus of the *Aquifoliaceæ*, accords with *Heisteria* in many remarkable points; they agree in habit and inflorescence, both having flowers in aggregated axillary clusters, growing out of imbricated buds; they have also a small 5-toothed calyx, a corolla of five petals partly cohering at base, but easily separable, with a valvate æstivation, ten stamens, five of which are opposite, and five alternate with the petals, and partly adhering to them, a trilocular depressed and somewhat stipitate ovarium, with a single ovule suspended in each cell, a short erect style, and a clavate stigma: this close approximation of characters is very apparent, but the subsequent development of the calyx is not recorded in *Rhaptostylum*, nor is the nature of its fruit known. The genus *Ptychopetalum* of Bentham also agrees with *Rhaptostylum* in its principal floral characters, but differs in its unilocular ovule with two suspended ovules, a nearly constant feature of the *Icacineæ*. From the description of Kunth, the three cells of the ovarium are symmetrical, and not lateral, as in *Pogopetalum*; and as the fact of the evanescence of the dissepiments at their summit probably escaped the observation of that botanist, we may safely conclude that *Rhaptostylum* will be found to belong to *Olacaceæ* rather than to the tribe of the *Icacineæ*, or to the family of the *Aquifoliaceæ*. *Iodina* again, which has always been referred to the last-mentioned family, really belongs, as I shall be able to show, to the *Olacaceæ*: this curious genus presents a minute cupshaped bractiform calyx, with an entirely free campanular fleshy corolla, half cleft into five acute lobes, with a valvate æstivation: a large fleshy cup-shaped disk, fixed on a distinct stipitate support within the corolla, surrounds the ovarium, and upon its margin the stamens are inserted; five of these are fertile, and placed opposite to the lobes of the corolla, the others are alternate, squamiform and petaloid, having been hitherto described as petals, but from their position

they are evidently analogous to the sterile stamens of *Agonandra*, a new genus of *Olacaceæ*: the depressed ovarium, partly immersed in the disk, is unilocular, with two to five ovules suspended from a cionosperm, or free central placenta. *Iodina* from its habit, with its spinous leaves more resembling those of the Holly, might well be supposed to belong to *Aquifoliaceæ*, but the æstivation of its corolla, and the peculiar structure of its ovarium, refer it, without doubt, to *Olacaceæ*. The genus *Iodina*, at first sight, offers a close resemblance to *Cervantesia*, which has in like manner five large petaloid scales, alternating with as many fertile stamens, and all originating in one common whorl, from the margin of a cupuliform disk; but in this genus the disk is not free, as in *Iodina*, but is entirely adnate with the tube of the floral envelope, so that when the fruit ripens, the drupe exhibits on its sides the persistent lobes of the corolla, and the petaloid stamens; but as the principal floral envelope must be regarded as a perigonium, having no calyx at its base, and as the disk is adnate with this perigonium, this genus must be referred to *Santalaceæ*, while *Iodina* and *Agonandra* must belong to *Olacaceæ*. There is one very unusual point of structure in *Cervantesia*, which appears to me without example; the floral envelope, deeply cleft above into five equal segments, is adnate to the disk, a little below the level of its free margin, but at this point it descends again below the same line of attachment, in the form of five other reverse segments, equal in size and continuous with the upper ones, and quite free from the disk and pedicel, which they enclose, so that it appears to consist of five elliptical segments, pointed and free, both above and below, and confluent only with each other and with the margin of the disk by a narrow transverse zone running across their middle: these inferior free processes must be spurlike extensions of the perigonium.

We have still another striking instance of the consimilitude in the external characters of the *Olacaceæ* and *Aquifoliaceæ*, which has led to a confusion of reference, in an opposite direction: this occurs in the genus *Bursinopetalum* of Wight, who assigned it to the former family, but which appears to me clearly belonging to the latter, as it agrees with it in the imbricate æstivation of its corolla; the petals, though distinct, and somewhat valvate at base, are decidedly imbricated for at least two-thirds of their length, two alternate petals being exterior to the others, and their margins overlapping to a considerable extent; they have the same prominent internal keel, and the apex is deeply inflected by long processes, which are torsively complicated together, as in *Villaresia*; the ovarium (probably from a similar cause) is unilocular, with an ovule (or two?) suspended on one side

from near the summit of the cell; so far all accords with the last-mentioned genus, but it differs in having its ovarium half immersed in the fleshy torus, which however occurs sometimes in *Ilex*. Although the ovarium is at first almost superior, it subsequently becomes inferior by the growth of the fleshy torus, or disk, and it is the lower portion only that acquires increment, for the fruit ultimately is invested by the enlarged calyx, now become adnate, and is crowned by its five persistent teeth, the originally superior portion of the ovarium, and the base of the style, forming an umbilical scar upon its summit. The most prominent feature, however, is in the development of the fruit, and its structural resemblance to that of *Villaresia*; this is a drupe containing a very thick ligneous putamen of considerable size, which is one-celled; but the longitudinal parietal placenta seen in the ovarium has now become so much thickened, and extended across the cavity of the cell, as to make it thus appear as if it were almost bilocular, and its single seed hence becomes inflected around the placenta, and made to assume the form of the cavity thus formed, which in its transverse section is hippocrepiform: the seed, as in the *Aquifoliaceæ*, has a copious albumen, with a small embryo near its summit, having a superior radicle, pointed towards its apex. From the identity of this construction to that of *Villaresia*, we may reasonably conclude, that in *Bursinopetalum* the more normal condition of the ovarium is also bilocular, which indeed is evident from the hollow, or longitudinal slit, lined with a distinct membrane, seen to extend down the middle of the thickened incomplete dissepiment, and which is most probably the vestige of the abortive cell. These facts all tend to prove, that however structurally opposed the *Aquifoliaceæ* may be to the *Olacaceæ*, they possess so many external characters in common, as to have led the most expert botanists of our time to confound the two orders, by placing several genera in one family that belong to the other, and *vice versâ*. I will here mention that *Pogopetalum*, placed by Mr. Bentham in *Olacaceæ*, differs from that order, and especially from all the other genera of his tribe *Icacineæ*, in which it is placed, by having its ovarium always completely 3-celled: from the lateral position of these cells, it is manifest that their normal number must be five, in correspondence with the other parts of the flower. This would bring the genus nearer in accordance with *Ilex*, but it differs from that genus and all others of the *Aquifoliaceæ* in the æstivation of the corolla.

In order to prevent the same confusion in future, it is very desirable to reduce the *Olacaceæ* within more uniform and certain limits, and I therefore propose to confine this family to those genera that have a free calyx, more or less entire; four to six

distinct petals, always valvate in æstivation, and sometimes adhering by the margins at their base into a somewhat gamopetalous tube, but which by a little force may be separated from each other without any laceration; stamens generally equal in number to the petals and opposite to them, sometimes double that number, in which case they are by turns opposite and alternate, or at times one half of them are sterile and appendiciform, or in shape of petaloid scales. Around the ovary are sometimes free hypogynous glands, alternate with the petals, but generally these are combined into a cup-shaped nectary, which in some instances, as in *Liriosma*, is free from the ovarium and partially adnate to the calyx; but in others, as in *Schöpfia*, *Iodina*, *Arjoona*, and *Quinchamalium*, it is wholly adnate to the ovarium and free from the calyx, while in *Cathedra* it is free both from the calyx and ovarium. This hypogynous disk, when developed, always bears on its margin the petals and stamens. The ovarium is always wholly superior with respect to the calyx, but often partly immersed in the cupuliform disk, and is frequently surmounted by a remarkable fleshy epigynous gland, which sometimes wholly covers its upper moiety; it bears a simple style, and a more or less clavate stigma. The internal structure of the ovarium is always constant in its character; unilocular at its summit, and more or less divided at base into incomplete cells, by spurious dissepiments, which separating from the axis, are often continued along the walls of the cell, in the form of so many narrow parietal keels. The placenta is axile, united at base with the short incomplete dissepiments, but quite free above, in the shape of an axile column, from which are suspended as many ovules as there are pseudo-dissepiments; these are generally three in number, more seldom two or five, and rarely by abortion only one, as occurs sometimes, but not always, in *Opilia*: this axile placenta, very distinct from the ordinary trophosperm, and which I have elsewhere proposed to call a Cionosperm (from *κίων, columella*), sometimes does not extend beyond the point of insertion of the ovules, while at others it rises above, in the form of an apical point, as in *Ximenia*, where it is prolonged far into a cavity of the style that is continuous with the cell of the ovarium, but in such cases it is always free and unconnected with it. One ovule only (as in the *Santalaceæ*) becomes matured into a fleshy drupe, which is sometimes supported at its base upon its unchanged calyx, while in others, as in *Olax*, *Heisteria*, *Cathedra*, and *Quinchamalium*, the calyx enlarges and encloses the fruit; and in some cases, as in *Liriosma*, the calyx increases in size, and becoming adnate, forms the fleshy external covering of the drupe. The putamen is one-celled, containing a single suspended seed; this, at first sight, presents a naked albumen filling the cavity, as in

Santalaceæ, but the membranaceous and pellicular integument will be found adhering to the inner face of the cell, and when separated, there will be seen on one side a funicular raphe-like thread, extending from the base to near the summit, which is merely the attenuated remains of the placentary column, with the abortive ovules, still visible, at the apical point of attachment to the integument. The embryo is small, terete, and seated in the axis of the upper portion of the albumen, the radicle being always superior, and the cotyledons very small and compressed, directed towards the centre of the nucleus. To such characters I have found the following genera correspond, viz. *Ximenia*, *Heisteria*, *Olax*, *Schöpfia*, *Strombosia*, *Cathedra*, *Iodina*, *Liriosma*, *Opilia*, *Arjoona*, *Quinchamalium*, and two new genera, *Agonandra* and *Endusa*. The order thus restricted is marked by more distinct and coextensive characters than those proposed by Mr. Bentham, and will be seen to comprise only his tribes *Olaceæ* and *Opilieæ*. The latter tribe however cannot be maintained, as I find that *Cansjera* does not belong to the family*, and that

* The genus *Cansjera*, first placed in the *Thymeleæ* by Jussieu, was retained there by all subsequent botanists, till removed to the *Olacaceæ* by Mr. Bentham, who concluded it was allied to *Opilia*, because he considered it to have a small distinct adnate calyx, and an unilocular ovarium, with a single ovule suspended from the summit of a free central placenta. All the specimens I have examined of both known species, from various localities, and in different herbaria, present characters constantly at variance with these conclusions and more in accordance with the description given by Lamarck (Dict. iii. 433). Here I can observe no trace of any distinct calyx, but the floral envelope, which is a simple tubular perianthium, is supported at base upon a small and pointed navicular bract: the four stamens are adnate in the upper portion of the tube, equal to the number of the lobes of the border, and opposite to them; four tridentated, free, hypogynous scales alternate with the stamens; the long conical ovarium is seated upon a narrow glandular support, from which the scales originate, and the style is surmounted by a large 4-lobed capitate stigma. The ovarium I find to be constantly 4-locular at base, and one or more (generally two or three) of these minute cells extend irregularly like narrow and interrupted channels, to the upper portion, and the fecundating threads may be traced from all of them, most distinctly, to the style: a single ovule is seen, sometimes higher, sometimes lower, from a prominent line of placentation on one side of each ovuliferous channel which at the point of the development of the ovule becomes widened, and here the placenta is somewhat curved, by the ascending direction of the ovule. The seed is a drupe, apiculated by the base of the style, and supported below by the remains of the shrivelled perianthium; it contains an oval coriaceous putamen, which encloses a single erect seed; a short receptacle is seen at the base of the cell, which enters into a corresponding hollow in the seed, and from it extend, in a cruciform direction, four prominent keels or ridges, which penetrate as many furrows observable in the albumen: the testa and integument are membranaceous, the albumen solid and fleshy, and an embryo of half its length is placed in the axis of the upper moiety: this embryo is slender, cylindrical, and terete, its superior radicle is oval, clavate, six times shorter

Opilia, although often with only a single suspended ovule, sometimes exhibits two or three ovules, as I have distinctly seen in *O. amentacea*. This fact was evidently more than suspected by Mr. Bentham, who says (*loc. cit.* p. 674) that it appeared to him there were two ovules in *Opilia*, three or four in *Cansjera*, a circumstance rendered probable by the evidently compound nature of the stigma in both genera, but which on account of the excessive minuteness of the parts he could not ascertain from dried specimens: after fecundation he never found traces of more than one ovule. The order however will admit of being divided into tribes, by some of the characters already indicated, but in a subsequent memoir I will offer my views on this subject.

As I shall have shortly to treat of *Leretia*, and other correlative genera, I shall be able to detail at greater length the numerous observations that have induced me to propose the separation of Mr. Bentham's tribe *Icacineæ* from the *Olacaceæ*; it will at present be sufficient to state, that they constantly differ in having the stamens alternate with, not opposite to the petals; they always want the hypogynous disk that forms so frequent and so remarkable a feature in that family, although they sometimes exhibit a similar epigynous gland upon a superior ovarium; they differ also most essentially in the structure of their somewhat gibbous ovarium, which normally will be seen to be 5-celled, but which with a single exception is by abortion always completely unilocular, and without the smallest indication of any free central placenta, the ovules being generally two in number, attached somewhat laterally, from near the summit of the cell. The fruit differs most essentially in structure from that of the *Olacaceæ*, being a drupe, enclosing a single nut, with a solitary albuminous seed, that is covered with the usual testa and inner integumental envelopes, and distinguished by a well-marked chalaza and raphe, which, as in *Euonymus*, is averse or dorsal in respect to the axis of placentation. This is very manifest in *Pennantia*, a genus clearly belonging to this family.

In a former page (*ante* p. 169), while speaking of *Villaresia* and *Bursinopetalum*, genera belonging to *Aquifoliaceæ*, I pointed out the existence of the identity of structure of the ovarium in those genera with that of the *Icacineæ*, and I stated many other circumstances, tending to prove how closely this tribe is related to

than the linear cotyledons, of which there were three, equal in size, in the specimen I examined: from the extremity of the cotyledons a thread extended to the umbilicus in the axis of the albumen, which was probably the remains of the embryonary sac. These characters cannot in any single respect be made to correspond with the *Olacaceæ*, and *Cansjera* must again be assigned to its former place, as an anomalous genus of the *Thymeleaceæ*, until a more fitting position can be given to it.

that family, and that its affinity with the *Olacaceæ* is in reality very distant. This very different structure of the ovarium did not escape the penetration of Mr. Bentham, but as he had not observed the constant, essential, and dissimilar points of floral structure, as above described, he states in the memoir before cited, that he did not consider the single fact noticed by him to be a sufficient reason for separating the *Icacineæ* from the *Olacaceæ*. It is evident however, from the many circumstances enumerated, that this group must form a distinct family (the *Icacinaceæ*), and it will consist of the genera *Icacina, Mappea* (Juss.), *Apodytes, Rhaphiostyles, Stemonurus* (identical with *Gomphandra*), *Leretia, Phlebocalymna* (Griff.), *Sarcostigma, Poraqueiba, Pennantia, Ptycopetalum, Pogopetalum,* and *Desmostachys*.

I am aware of the objections that will be raised by some botanists, who are averse to multiplying the present number of orders, but it appears to me most important to the advancement of science, to detect in the various natural groups of plants, a few decisive characters, by which they can be readily distinguished, and this should be accomplished, even at the risk of increasing the number of families: this indeed is a far less evil than the opposite extreme, where, by reducing too much the divisions of the system, the most opposite characters often become blended in one group, and we thus lose sight of every useful and well-defined line of demarcation. This inconvenience was pointed out on a former occasion (Illustr. South Amer. Plants, vol. i. p. 167), when I proposed the family of the *Atropaceæ*, but I then suggested, that if this were felt to be an evil, it might be counterbalanced, by classing in one immense family the *Scrophulariaceæ, Solanaceæ, Atropaceæ*, &c., which all partake of many similar general characters. In like manner the *Celastraceæ, Aquifoliaceæ, Icacinaceæ*, and perhaps some others, might be considered as suborders, but I am not yet prepared to define the exact limits of such a group. The same observations will equally apply to what I have said farther on, relative to the *Viscaceæ*.

We have now arrived at that point in this investigation, when we can better understand the exact relation existing between the *Olacaceæ* and the *Santalaceæ*, to which I have already alluded. The details given of the structure of *Cathedra* and *Liriosma* enable us to comprehend more fully the true nature of the floral parts seen in *Santalaceæ*. In the *Olacaceæ* we have observed that the ovarium is always superior, and quite unconnected with the real calyx, and that the cupshaped disk, which supports on its margin the corolla and the stamens, is sometimes, though not always, adnate with the ovarium, growing with it in such

case, and producing a pseudo-inferior fruit, but which, in truth, never ceases to be superior. This we perceive in *Myoschilos*, a genus placed hitherto in *Santalaceæ*, where the hypogynous disk is adnate with the ovarium, and quite free from its triphyllous calyx, the stamens and petals being inserted on the margin of a free portion of the disk; thus it agrees with *Schöpfia* in all essential points of structure, except that its calyx consists of three distinct sepals, instead of being an urceolate 5-toothed tube. In *Quinchamalium* we meet with a still nearer approach to the last-mentioned genus, for its calyx is also quite free, and in the form of an urceolate tube with a 5-toothed border; we have likewise a similar fleshy hypogynous disk, wholly adnate with the ovarium, and bearing on its margin a gamopetalous corolla; here also we perceive a similar development of the very prominent epigynous gland, that covers the somewhat depressed conical apex of the ovarium, but in this instance it rises in the form of a 5-grooved cylindrical tube, with a border of five rounded patent lobes, encircling the base of the style, and quite free from it. In *Arjoona*, as in *Myoschilos*, the calyx consists of three imbricate leaflets, but the outer one is considerably larger, and being 3-nerved, it consists probably of three confluent leaflets, so that the normal number of its sepals will hence be five, corresponding with that of the lobes of the border and stamens: the hypogynous disk is here less conspicuous, but it still exists, wholly adnate and continuous with the tube of the corolla: the epigynous gland is highly developed, being entirely free from the base of the corolla, by which it is concealed; the style originating on its umbilical and rounded apex. These three genera have hitherto been placed in *Santalaceæ*, but it is evident that to whatever order they belong they must be classed side by side with *Schöpfia*, a decidedly *Olacaceous* genus. In all the genera of the *Santalaceæ*, we meet with the presence of a large cupuliform disk, supporting the stamens externally on its lobed margin, and forming a most prominent and constant feature, but with this difference, that while in *Olacaceæ* this disk is frequently adnate with the ovarium and free from the calyx, in *Santalaceæ* it never invests the ovarium, but is adnate with the tube of the perigonium or calyx, forming generally a deep cup about the superior moiety of the ovarium, which in most of its genera is only half inferior: the cupshaped disk, in these cases, is therefore continuous with the fleshy epigynous gland. I am aware that it might be, as it has already been contended, that in *Schöpfia* its disk may be looked upon as an adnate calyx, its corolla as a perigonium, and its calyx as a tubular involucre; but such an argument can no longer be tenable when confronted by the structure seen in *Liriosma* and *Cathedra*, where we find a true solu-

tion of the nature of the cupuliform disk. There is however always this essential difference constantly existing between the two families: in the *Olacaceæ* the insertion of the corolla and stamens is on the margin of the disk; in the *Santalaceæ* this insertion is always outside of it; in the former these organs are articulated with it, and easily fall away; in the latter family it is impossible to separate the free lobes of the perigonium and stamens without force, and a rupture of the parts. But notwithstanding these prominent marks of ordinal distinction, there exists a regular gradation from one family to the other, as will be seen from the analyses I propose to offer; this proceeds from one extreme, *Opilia* (where the disk is developed in distinct free glands), through *Agonandra, Olax, Liriosma, Cathedra, Schöpfia, Arjoona, Quinchamalium, Myoschilos, Iodina, Cervantesia, Mida, Exocarpus, Santalum,* &c., rendering it difficult, through the osculant genera *Iodina* and *Cervantesia,* to draw a line through the strong limits of demarcation that exist between the two families.

The word *torus* has been employed by Mr. Bentham (Linn. Trans. xviii. p. 676) to describe in *Olacaceæ* what I have termed a *disk,* and which I have shown to be the same organ, but differently situated, that forms a constant feature, both in that order and the *Santalaceæ,* where in both cases, with rare exceptions, it is always deeply cupuliform and more or less lobed on its margin. I have adopted in preference the term "discus cupuliformis" as that given by Dr. Lindley for such a structure in his 'Introduction to Botany,' p. 161. This may not differ in its nature from a stipitate torus, but the adaptation in such cases of this last term, which is generally used in another sense, will naturally lead to ambiguity in our definition of structural arrangement; thus Mr. Bentham, in a subsequent work, appears to agree with Dr. Hooker's observation, after an original suggestion of Mr. Brown, in what appears to me an inconsequent conclusion, viz. that because in *Olacaceæ* the corolla is inserted into the disk, which is sometimes stipitate, or what he calls the apex of the pedicel, that the calyx in such case should be considered in the light of an involucre (Flor. Nigrit. p. 261). I can perceive no reason why this should be a necessary consequence, for we see in the *Capparidaceæ* the development of the stipitate torus carried even to a much greater extent, supporting the stamens on its sides and the petals below them; but no botanist in these instances has ever thought of considering the calyx to be of the nature of an involucre, which it ought to be if the above reasoning were valid: this incongruity is rendered still more evident, when we remember that the argument was applied in the case of *Rhaphiolepis,* a genus of the *Icacineæ,* which I have shown

to differ little from the *Aquifoliaceæ*. The word torus is generally confined to that fleshy termination of the peduncle in the bottom of the calyx seen in *Ranunculaceæ*, and more especially developed in such orders as the *Anonaceæ*, *Magnoliaceæ*, &c., but when it rises in more varied or determinate shapes, it takes the name of hypogynous glands, annular ring, flat, pulvinate or cupuliform disk, &c., according to the peculiar form it may assume, or the position in which it is engendered.

The epigynous gland, so highly developed in *Schöpfia*, *Arjoona*, *Cathedra*, and other genera of the *Olacaceæ*, is an equally constant feature of the *Santalaceæ*, where in *Exocarpus aphyllus* it is largely and prominently seen in the form of a 4-lobed cushion, broader than the summit of the ovarium, which is almost entirely superior; this is quite independent of its hypogynous disk, which is also present as usual in the family. This organ, whose existence I first pointed out in *Hyoscyamus*, I have since found to occur frequently upon the summit of a superior ovarium.

This inquiry into the affinities of the *Olacaceæ* has led to another conclusion of some interest. In my memoir upon *Cathedra* (*huj. op.* vol. vii. p. 454), while describing its curious anthers, I pointed out a very analogous structure in *Choretrum* and other genera, mentioning at the same time a similar formation of the anthers in *Myzodendron*, so beautifully illustrated in the 'Flora Antarctica' by Dr. Hooker, who has there also given the analysis of its ovarium and fruit, proving by indisputable evidence its relation to the *Santalaceæ* and *Olacaceæ*. I will now endeavour to show, that neither this genus, nor *Viscum*, bear any relation to the *Loranthaceæ*, where they have been placed by almost every botanist. The genus *Viscum* has been a frequent subject of investigation by many eminent physiological botanists, and Richard first described the very remarkable structure of the anthers of *Viscum album*, of which we find no parallel formation: these are well represented (Ann. Mus. tom. xii. tab. 27) as being composed of very numerous cells, each containing distinct aggregations of pollen-grains, and which burst open and discharge their contents by the rupture and contraction of the vesicular tissue that covers their surface; in this respect it bears no resemblance to the structure of the anthers of *Myzodendron*. On the other hand, upon examining the anthers of the Brazilian species of *Viscum*, I find their structure quite opposed to that described in *V. album*, and somewhat analogous to those of *Myzodendron*; they are 2-lobed and subcordate, approaching much the form of those of *Cathedra*; they are quite distinct and free from the lobes of the perianthium, are nearly sessile, and consist of two parallel cells, enclosed in thick crystalline walls, as described in that genus, and appear to discharge their fertilizing power in the same ambiguous manner by two covered pores in the apex: the pollen

is globular, quite smooth, vesicular, bursting irregularly, and so thin is their texture, that the sporular granules can easily be distinguished in them by transmitted light. All such species will therefore constitute a group generically distinct from *Viscum*, to which the name of *Allobium* may be given, from ἄλλος, *alius*, βιόω, *vivo*, in allusion to their deriving their support and nourishment from other trees. As far as my observation extends, many of the Asiatic species will be found to conform with the same genus. On some future occasion I will give more in detail the facts upon which I propose to separate from the *Loranthaceæ*, the genera *Viscum*, *Myzodendron*, and *Lepidoceras*: respecting *Eubrachion* and *Ginalloa* I cannot offer an opinion: *Antidaphne* from Pöppig's description is evidently related to *Loranthaceæ*, as well as *Tupeia* *, on account of the structure of the ovarium.

It will be sufficient to remark at present, that in *Loranthaceæ* the flowers are generally hermaphrodite; the calyx, with a free and entire margin, is adnate with the ovarium; the petals are linear, frequently very long; the opposite stamens with lengthened filaments are free or only partially adnate with the petals; the anthers often versatile, always 2-lobed and 4-celled, bursting by two longitudinal furrows; the pollen is flattened, 3-lobed, and marked by three lines radiating from the centre; the ovarium is unilocular with a single ovule suspended from the summit of its cell; and the embryo, with large fleshy cotyledons, almost fills the cavity of the cell of the fruit, being covered with very thin albumen: finally they often form distinct trees, are frequently more epiphytic than parasitic, and the inflorescence is generally paniculate, with numerous pedicelled flowers, often of great size and brilliant colours. We perceive nothing like this in *Viscum*, *Myzodendron*, or *Lepidoceras*, where the flowers are always very minute, either diœcious or monœcious, and generally imbedded in decussate pairs in a fleshy spikelet. In the group I have called *Allobium*, the structure of the flower corresponds with that of most of the genera of the *Santalaceæ*, the calyx is obsolete, the corolla or perigonium has three or four short and 3-angular lobes, the sessile anthers already described are opposite to these segments, and alternate with the lobes of an internal adnate disk;

* I have had an opportunity of examining the *Tupeia Cunninghamii*, which scarcely differs from the typical species, *Viscum antarcticum*, Forst.; it agrees with the characters assigned to it by Forster, Chamisso, and Schlechtendahl (Linn. iii. 203), Richard (Voy. Astrol. p. 269), and Miquel (Linn. xviii. 85). At the same time that it is in no way related to *Viscum*, it quite accords with the *Loranthaceæ*, and agrees in every respect with the characters given in Endlicher's 'Gen. Pl.' p. 802, of *Spirostylis*, a subgenus proposed by Presl and adopted by Blume (DC. Prodr. iv. 315). This species from Acapulco will therefore claim the name of *Tupeia Haënckeana*, *Spirostylis Haënckeana*, Presl, the former genus being proposed in 1828, the latter in 1829.

in the female flowers, also 3- or 4-lobed, the ovarium is half immersed in a similar adnate fleshy cupshaped disk; it is 1-celled, with three ovules suspended from a free central placenta; the berry contains a single naked seed, enclosing a compressed heart-shaped albumen, with a minute embryo in its almost cordate summit; the radicle is terete, the upper moiety of which is nearly exserted, having only a thin pellicular albuminous covering; while its lower moiety, and two exceedingly diminutive cotyledons, are imbedded within the substance of the albumen, in the marginal sinus. These characters are so perfectly distinct from the *Loranthaceæ*, that it appears to me the genera above mentioned should form either a separate family (the *Viscaceæ*), or be considered as a suborder of the *Santalaceæ*. The only points of resemblance between *Viscum* and the *Loranthaceæ* are, the position of the stamens opposite the lobes of the corolla or perianthium, the manner of development of their seeds, their glutinous properties, and their parasiticism, characters equally possessed by other families: they are certainly quite distinct in habit. Mr. Griffith states, that the Indian species of *Viscum* have three ovules suspended from a central column, thus agreeing with the Brazilian species, which I have called *Allobium*. The ovules of *Viscum album* are said by M. Decaisne to be erect, but I have elsewhere offered reasons why we may infer that they are in reality suspended, and only apparently erect, as in *Champereia*, &c.

In first pointing out the affinity of the *Loranthaceæ* with the *Santalaceæ*, many years ago (Prodr. 352), Mr. Brown probably had *Myzodendron* and *Viscum* in view, as at a later period (Linn. Trans. xix. 232) he has alluded more distinctly to the similarity in the construction of the ovarium of the former genus with that which forms a pecular feature in the *Santalaceæ*. In indicating, on the other hand, the relation of the *Loranthaceæ* with the *Proteaceæ* (Flind. Voy. App. 549), the same distinguished botanist probably had only *Loranthus* in consideration. The evident affinity of *Viscum*, just mentioned, was also remarked by Prof. Decaisne, in his memoir on the pollen of that genus, before cited, on comparing the ovules of *Viscum album* with those of *Thesium*. Brongniart (1843), adopting this view, arranged the *Loranthaceæ* in a separate class, with the *Santalaceæ* and *Olacaceæ*. The same affinity between these three families (at least as far as regards *Myzodendron* and *Viscum*) has since been confirmed by Dr. Hooker, in his very able investigation into the relations of the former genus (Flor. Antarct. 293); and the strongest evidence in proof of this affinity is given in the complete analysis of its ovarium, from its early development to the perfection of the fruit, the details of which are there exemplified in plate 104. fig. 10 to 20, and plate 105. fig. 12 to 21.

After reviewing all that is here advanced, in regard to the affinities of the *Olacaceæ*, it is satisfactory to know that the conclusions to which my own observations have led me have been in great measure already anticipated by the inferences of such distinguished botanists: it is therefore with more confidence that I now repeat the suggestion proposed some time ago (*huj. op.* vii. p. 207), of uniting the several families distinguished by the characters there indicated into a distinct class (*Cionospermæ*), the place which it should occupy in the system having been already made obvious. If we look to the development of the reproductive organs in plants as a main element in the foundation upon which every natural method of classification should be based, then the arguments before adduced on this head ought to be considered with all the weight due to them (*ante* p. 166). I have there pointed out what appears to be the normal construction of the carpels in this group of families, and the sources from which the placentæ and ovules spring, and have again contrasted this with the normal structure of other classes of the system, the clear inference being, that the *Cionospermæ* should range in the *Thalamifloræ*, between *Polycarpicæ* and *Rhœades* (*ante* p. 166). Whatever may be conceded on this point as regards *Olacaceæ*, it may perhaps be objected, that a position so high in the scale is not compatible with the *Santalaceæ*, generally placed in a far lower grade; but if we consider the usual floral parts to be there existing and perfect, as we must admit from analogy, although but sparingly developed, this cannot be urged as a sufficient reason against the admission of that family into such a position, especially when no objections have been urged against the station assigned to the *Menispermaceæ*, placed in the midst of other families possessed of an unusually high extent of development in its floral parts, merely because its petals are reduced to the size of minute scales and its flowers very diminutive and dicœcious. Neither did DeCandolle hesitate to arrange the *Myristicaceæ* in a similar position, although they have small dicœcious flowers, with a simple perigonium; nor have any obstacles been raised against such a position by other botanists upon this score alone. Another objection may be urged, that in *Santalaceæ* the seed is often naked*, that is, deficient of any testa or integuments; but this is perhaps not always so, and its occurrence here, as we

* I do not use this term in the meaning employed by Linnæus, for seeds developed upon a gynophorus, such as *Labiatæ*, &c.; nor as used by Mr. Brown, to denote the seeds of *Coniferæ*, *Cycadeæ*, &c., in which sense it is now generally understood; but as no expression has been applied to the peculiar development under consideration, I would suggest that of *Semina exutiva*, as more peculiarly fitted to specify those, distinguished by the absence of the usual seminal tunics, contrary to the ordinary development in *Semina indutiva*.

know it to be in other cases, is probably due to adventitious causes. We have every reason to believe, that the development of the ovule and its embryo in the *Olacaceæ* is analogous to what has been observed in *Santalaceæ*: assuredly the early growth of the ovules is effected under the same peculiar circumstances, and in the seeds of *Liriosma, Ximenia,* &c., the albumen appears naked, or at least, their only covering is reduced to a thin membrane, which in the dried state remains more or less attached to the inner surface of the putamen. The phænomenon of the development of these, which I have proposed to call exutive seeds (see last note), has been frequently observed by many eminent physiological botanists, more particularly by Mirbel, Schleiden, Meyen, Decaisne, and Griffith. The latter has shown, that among the changes that take place in these cases, is the constant prolongation of the embryonary sac, outside of the "nucleus*," or body of the ovule, and that it is curious to witness the rapidity with which this exserted portion grows, and here becomes filled with albuminous tissue: another result being the incorporation of the remaining portion of the sac with that tissue. A similar prolongation of the embryo-sac was also noticed by the same accurate observer in *Avicennia*†, and he infers that this phænomenon has only been remarked in cases associated with a particular form of free central placenta‡; but this is not correct, for we have evidence, that its occurrence is not constant among the *Cionospermæ*. We know likewise, from the observations of Mr. Griffith himself, that the same occurs in *Congea, Loranthus,* &c. Dr. Planchon also has minutely described a similar phænomenon in the seeds of *Veronica*§, where the embryo is formed without the usual integuments, and remains covered merely by its embryo-sac, that protrudes outside the main body of the ovule, improperly called the "nucleus," and which afterwards shrivels into the form of a secondary funicular cord: in these instances the embryonary sac becomes thickened, and assumes the appearance of a perispermal covering around the albumen of the seed, very different in its origin from the true testa of indutive seeds.

* This term, though generally used in this case by botanists, is manifestly incorrect, and has been employed only because it is applied to the identical body which is enclosed within its several tunics in ordinary seeds; it leads to misconception, because it is difficult to imagine the "nucleus" can mean the external covering of the ovule, while the protruding real nucleary body becomes the entire seed. It would be more conformable to fact, and render the details of the phænomena more intelligible, to denominate the former, what it really is, the external body of the ovule, and not a "nucleus."

† Linn. Trans. vol. xx. p. 2.

‡ *Ibid.* p. 3.

§ Mémoire sur les développemens et les caractères des vrais et faux arilles. Montpelier, 1844.

We may infer that nearly the same changes take place in the development of the seed in *Olacaceæ* that Mr. Griffith has so minutely observed in *Santalum* and *Osyris*; for in the ripe fruit of *Liriosma*, examined in the dried state, independently of the thickened and lengthened cionosperm, which is pressed into a deep longitudinal groove, formed by its pressure, in one side of the albumen, I find constantly, midway between the axis and this groove, and imbedded in the substance of the albumen, a very distinct, long, cylindrical, membranous tube, which proceeding from the base terminates abruptly, by an almost truncated closed apex, at about half the length of the seed; the lower portion, at its exit, is reflected upwards round the base, for a short distance, in a small groove, and is soon gradually lost in the substance of the enveloping integument. We cannot imagine this tube to be anything else than the posterior end of the embryonary sac, which in *Osyris* Mr. Griffith describes as becoming incorporated with the nascent albuminous tissue, but which here appears to remain entire, and its existence in the position above described can only be accounted for by supposing its reduplication during the development of the albuminous tissue. On dividing the putamen, the albumen will be found quite bare of any integumental covering, except at the lacerated margin of the cionosperm, around the hollow space at the base, and about the summit, where it has broken away from the abortive ovules, which as well as the cionosperm become entirely pressed into the substance of the albumen: the rest of the extremely thin integumental covering remains adhering to the inner surface of the putamen; but whether the external body of the ovule becomes withered and contracted into the substance of the cionosperm, or whether its induvial remains are to be referred to the quantity of colourless, dislocated tissue found between the adherent membranes that form the lining of the putamen and the seminal integument, it is impossible to determine from an examination of dried specimens.

Besides the knowledge of the singular fact of the exsertion of the embryonary sac, and the development of the embryo outside of the body of the ovule, common to the *Santalaceæ*, and by analogy to the *Olacaceæ* and other *Cionospermæ*, that of the confluence of the albumina of several sacs into one albumen is stated to occur in *Viscum album*: this however is not quite a manifest explanation of the phænomenon, for if these were confluent, the embryos would not unite at base, but would remain distinct, by the intervention of the confluent sacs, unless we imagine these membranes to become absorbed into the substance of the nascent albumen. Dr. Meyen, on the contrary, denies the fact so minutely described by M. Decaisne, in the memoir

before quoted, of the growing together of several embryos; for he asserts, that several embryonary sacs are contained in a single ovule, and are fertilized, but it rarely happens that more than one of these arrives at perfect development*, and he therefore concludes, that the doubling or trebling of the radicular end of the embryo of *Viscum* cannot be owing to the cohesion of several embryos. It appears to me that many of the changes that really take place in such cases have not yet been observed, and that we have still much to learn concerning the true nature of such developments: this is a subject of deep interest, worthy of the most attentive examination. I have mentioned that in the *Olacaceæ*, as well as the *Santalaceæ*, although the cionosperm sometimes exceeds the limits of the ovules, the free apices of the three ovular bodies are more frequently seen to extend above the top of the column. M. Decaisne describes the ovules in *Viscum album* to be several and erect, that one of these becomes fertile, while the two others are abortive and appear like filaments at its base. It is probable that the cionosperm is here very short, and that the free apices of the ovules have been mistaken for the ovules themselves; it may be also that the free apices of the probably yet unimpregnated ovules, distinguishable in the ovarium of the *Olacaceæ*, *Santalaceæ*, &c., may be nothing more than the exserted portions of the embryonary sacs, so ably described by Mr. Griffith: these are points very difficult of determination in dried plants especially, where the parts are so extremely minute and delicate. In *Opilia*, and again in *Champereia*, the three suspended ovules, at the period of the fall of the flower, appear closely aggregated upon their columnar support, and from their extreme minuteness, they are easily mistaken for a single erect, stipitate ovule; but I have found, by alternately moistening and allowing them to dry, that air intervenes between the delicate membranes, and renders them clearly distinct. I have already alluded to the fact, but as yet we know nothing of the cause, of the non-production in all the *Cionospermæ*, as well as in *Viscum*, of the usual coverings that in ordinary cases are generated over the pristine ovule. We must not lose sight of the important circumstance, observed by M. Decaisne, that in *Viscum album* the embryo is not developed till a long period after the fall of the anthers†, nor of those of Mr. Griffith‡, equally showing, that both in the Indian species of *Viscum* and *Loranthus*, the ovulum is a formation, subsequent to the act of impregnation; "a remarkable and unparalleled fact, that tends to increase the difficulty of understanding, or even conjecturing, the nature of

* Ann. Nat. Hist. Ser. 1. vii. p. 171.

† Sur le développement du Pollen du Guy, &c., Mém. Acad. Roy. Bruxelles, vol. xii.

‡ Linn. Trans. vol. xviii. p. 77.

the first steps in the formation of an embryo." These considerations become analogically of importance in leading us to the discovery of the real history of the *Olacaceæ*. Something in relation to this subject might be learned, if we could better understand the origin and development of the embryo under ordinary circumstances, for the facts are still undetermined that can prove which of the two theories of the nature of vegetable reproduction is founded on truth; the one maintaining that the pollen-grain penetrates the embryo-sac, and hence comes into immediate contact with the body of the nucleary vesicle, in order to effect its fertilization; the other denying this assertion, and declaring that it does not penetrate the sac, but merely discharges its function of impregnation, by external impression. Similar theories have long been disputed among zoologists, some contending that the spermatozoon does not penetrate the ovum in order to effect its impregnation, as mere external impact is sufficient to accomplish this function, while others declare the necessity of immediate contact, and that in proof of this they have seen the spermatozoa within the shell of the ovum. This point has just been determined by Mr. Newport, in a very interesting paper read before the Linnæan Society, in which he proves satisfactorily that the former view is conformable to truth. He has ascertained the important facts, that the presence of active spermatozoa are absolutely necessary to impregnate the ovum; that this is effected by simple impact; he has noted the time necessary to complete the operation, and has observed the internal change that immediately takes place in the body of the nucleus; and moreover he has found that the spermatozoa, after producing this effect by simple external impact, become inert and lose all power of motion. Mr. Newport has suggested that these circumstances, by analogy, may assist in determining the theories in dispute among vegetable physiologists; and he has pointed to the curious fact recorded by Mr. Griffith (Linn. Trans. vol. xx. p. 393) of the irritability or oscillatory motion seen within the boyaux of the pollen-grains of *Dischidia* at the period of impregnation of the ovules, which may perhaps be in some degree analogous to the vivacity of spermatozoa under parallel circumstances.

XVI.—*Geographical Notices, and Characters of fourteen new species of* Cyclostoma, *from the East Indies*. By W. H. Benson, Esq.

The following new species of an interesting genus of operculated Land-snails belong chiefly to the mainland of India, and were collected in the Sikkim Himalaya; among the hills to the north-east of Bengal, and in the Peninsula of Southern India, from the